Patent Application of

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for

Soap Film Forming and Viewing Toy

RELATED APPLICATIONS

The present application claims the benefit of priority from copending provisional applications 60/429,120 filed on 11/26/2002 and 60/438,285 filed on 01/06/2003.

FIELD OF THE INVENTION

The present invention relates generally to soap bubble toys and toys for viewing soap films. Particularly, the present invention provides a toy that can form and hold a soap film for easy viewing.

BACKGROUND OF THE INVENTION

Soap films and other thin, freestanding liquid films create striking colorful patterns by optical interference effects. The prior art includes many devices for forming and viewing soap films. However, none of the prior art devices have succeeded in providing a simple, easy-to-use, and inexpensive device for rendering soap film colors visible.

Examples of the prior art include:

US patent 3,945,722 teaches a color pattern generator. In this device, the soap film is created by a motorized assembly.

US patent 4,540,368 teaches a soap bubble holder. The soap film is not enclosed and the soap film is part of a bubble disposed in the device.

US patent 4,914,955 teaches a flowmeter that measures the rate of soap film motion. The soap film is formed by dipping the end of a pipe in soap water.

US patent 1,048,801 teaches a device for spinning a soap film.

US patent 4,205,481 teaches a device for viewing and preserving a soap bubble.

US patent 4,808,138 teaches a device for making soap bubbles.

US patent 3,971,157 teaches a device for making bubbles under a transparent dome.

US patent 4,257,185 teaches a device for forming a bubble inside a container.

US patent 4,133,124 teaches a device for viewing colors of a soap bubble.

SUMMARY

The present invention includes a device for viewing a liquid thin film having a container, a frame within the container and a slider within the container. The frame is for holding the liquid thin film. The slider is for creating the film in the frame. The slider creates the film by moving across the frame.

The slider can move under the influence of gravity when the frame is tilted. Alternatively, the slider can move under the influence of magnetic forces created by an external magnet or ferromagnetic object.

The slider may move across the frame by translational motion, or by pivoting motion.

The container preferably has a clear window for viewing the film, and a frosted window for providing diffused light.

The container may be hermetically sealed.

The slider can be flexible or rigid.

The container can be filled with a gas that has been filtered to remove microscopic particles.

The container and frame can be designed so that the film is held at an angle within about 20 degrees of horizontal when the container is resting on a horizontal surface.

A vibratable element (such as a spring) can be attached to the exterior of the container. The vibratable element creates standing waves in the film when vibrated.

Additionally, the container can be designed so that it is bistable and has two stable resting positions when placed on a horizontal surface.

DESCRIPTION OF THE FIGURES

Fig. 1 shows an embodiment of the present invention.

Fig. 2 shows a cross-sectional view of the embodiment of Fig. 1.

Fig. 3 shows a close-up view of a slider disposed on two rails.

Fig. 4 shows an embodiment of the frame wherein the slider moves by pivoting.

Fig. 5 shows the pivoting frame embodiment of Fig. 4 disposed within a container, wherein the slider is movable by an external magnet.

Fig. 6 shows an alternative embodiment having an opaque tube circumscribing the clear window.

Fig. 7 shows an alternative embodiment of the invention.

Fig. 8 shows an embodiment of the frame wherein the frame has wavy rails.

Fig. 9 shows a cross-sectional view of an embodiment having a square container.

Figs. 10a and 10b show a bistable embodiment that has two stable positions when placed on a flat surface.

Figs. 11a and 11b show a second bistable embodiment that has two stable positions when placed on a flat surface.

Fig. 12 shows an embodiment having a vibratable spring that can create standing waves in the film.

Fig. 13 shows an embodiment having sloped rails.

Fig. 14 shows an embodiment where both rails are sloped.

Fig. 15 shows an embodiment where the frame is rotatable within the container. The frame is rotated by moving external magnets.

DETAILED DESCRIPTION

The present invention provides a device for forming and viewing a soap film. The device includes a container having a frame for holding the soap film, and a slider for creating the soap film in the frame. The slider moves (e.g. pivots or slides) within the frame to stretch the soap film across the frame. The slider can be moved under influence of gravity by tilting the container, or by an external magnet or ferromagnetic element. The container includes soap film-forming liquid (e.g. water soap and glycerin). The container can be hermetically sealed. The container preferably has a transparent window, a frosted window and black, opaque walls. The frame is positioned so that light enters through the frosted window (which diffuses

the light), reflects from the soap film and exits through the transparent window. Also, the soap film is positioned in front of the black walls when viewed through the transparent window. This structure provides an enclosed device for easily forming and viewing the soap film.

Fig. 1 shows a preferred embodiment of the present invention. A container 10 contains a film-forming liquid 12 such as a water, soap and glycerin solution. Rails 14 are rigidly attached to the interior of the container 10. Rails 14 are optionally straight and parallel as shown. A slider 16 is supported by the rails 14 and is free to slide along the rails as indicated by arrows 18. A soap film 22 is disposed between the rails 14. Rails 14 comprise a "frame" for holding the soap film 22. The soap film 22 is approximately horizontal (within about 20 degrees) when the device is resting on a horizontal surface.

Fig. 2 shows a cross sectional view of the device of Fig. 1. The soap film 22 is suspended between the two parallel rails 14. The container has walls 36 which are black and opaque. Window 34 is frosted or translucent. Window 32 is clear and transparent. The clear and frost windows can be angled with respect to one another by an angle A of about 30-150 degrees. Light rays are illustrated by arrows.

Fig. 3 shows a cross sectional closeup view of the slider 26 and rails 14. The slider preferably has a loop 17 around each rail. The loops 17 allow the slider to hold onto the rails and slide along the rails. Optionally, the loops 17 can have ridges 19 for holding the film-forming solution as is known in the art of bubble-forming wands.

In operation, slider is moved along the rails 14 to form a film. The slider 16 is free to slide along the rails 14 under the influence of gravity. When the container is tilted by rotating about axis 20, the rails 14 are inclined and the slider 16 moves along the rails, thereby stretching the soap film 22 across the frame defined by rails 14. The slider may need to be wetted by contact with the solution 12 before the film 22 is created. Ridges 19 help the slider distribute solution 12 along the rails 14. Also, the slider may comprise an absorbent material such as a sponge to distribute the film-forming liquid.

When used for viewing, the device is held up to a light source so that light passes through the frosted window 34 and becomes diffused. Diffused light from the frosted window 34 reflects from the soap film 22 and exits through the clear window 32 and is then seen by an observer. This is illustrated in Fig. 2.

The light source can be a battery-powered light source (e.g. light-emitting diode or incandescent bulb) that is attached to the container. The light source can also be sunlight or any other source of light.

In one embodiment, the slider 16 includes a magnetic element 24 (e.g. a magnet or ferromagnetic object). Outside the container, an external, movable magnetic element 26 is provided. Each magnetic element 24 26 can comprise a magnet or ferromagnetic object. When the slider 16 moves to the right side of the container 10 as seen in Fig. 1, the magnetic element 24 and external magnetic element 26 are attracted to and mechanically attach to one another, thereby immobilizing the slider 16. This feature allows the slider to be immobilized after a soap film is formed. Immobilizing the slider 16 is useful for film viewing because the slider 16 can erase or disturb film colors if it slides along the rails 14.

Many different materials can be used to construct the present device. The container can be made of plastics such as polystyrene, polycarbonate, acrylic or the like. The rails 14 and slider 16 can be made of similar or the same materials. The frosting of the frosted window can be provided by chemically etching or mechanically abrading the container, or by a sheet of tracing paper or plastic sheet with matte finish attached to the container. Preferably, if metals are used, only inert metals (e.g. stainless steel) are used within the container, since metals tend to damage film forming liquids. The black walls 36 can be provided by black plastic or paper sheet or black paint applied to the container. The soap film 22 or container can have a size in the range of 1x1 to 20x20 inches for example.

The clear window 32 can include a lens for viewing the soap film. The lens can be molded into the clear window 32, for example. In this case, the lens should have a focal length greater than the distance between the lens and the soap film, as this allows one to view a magnified, non-inverted image directly with the lens.

Also, before being sealed closed, the container is preferably flushed with gas that has been filtered to remove microscopic particles. Microscopic particles within the container can cause the soap film to break prematurely, and so removing particles from the container helps to ensure that the soap film is long lasting. With particles removed, the soap film can frequently last for 1-3 days.

Also, the container is preferably flushed with nitrogen or other inert gas. Oxygen or other reactive gases can degrade the film forming liquid.

Also, the film-forming liquid may have an anti-fungal compound for inhibiting the growth of yeasts or other microorganisms.

Preferably, the container is permanently and hermetically sealed. It can be sealed shut by radiofrequency welding, ultrasonic welding, or solvent-based welding or the like. Alternatively, the container has an opening such as a screw-top opening that allows a consumer to open the container and replace the film-forming liquid, for example. If a screw-top opening is provided, it should allow for a fluid-tight seal.

It is important to note that the present device should be designed so that the soap film is stably retained within the frame. Soap films constantly seek to minimize surface area due to surface tension. Therefore, if the soap film can attain a reduced surface area by slipping out of the frame, then the frame cannot hold the soap film. For example, if the container is overfilled with soap solution 12, then for certain tilt angles, the soap film will slip out of the frame by sliding along the surface of the soap solution 12. Therefore, it is important not to overfill the container with soap solution. Also, the shape and location of the frame can influence the stability of the film. The frame should be designed so that the film is stable.

Fig. 4 shows the slider 16 and frame in another embodiment of the present invention. The slider 16 pivots at pivot point 48. Slider can pivot between rails 46. Slider has a loop 21 that wraps around rail 50. The soap film 22 is held in frame comprising rails 46 50. The rails and slider of Fig. 3 are disposed within a container (e.g. container 10), which is not shown for clarity. The pivoting slider can be moved by gravity when tilted, or by an external magnet. One of the rails 46 in this embodiment should be flush with a container wall (e.g. attached to the container wall) so that the slider 16 can be wetted by the solution.

Fig. 5 shows an embodiment where the pivoting slider is movable using an external magnet 35. In this embodiment, loop 21 can be made of ferromagnetic material such as ferromagnetic stainless steel. Alternatively, a magnet or ferromagnetic object can be adhered to the loop 21. Magnetic coupling between the external magnet 35 and the loop 21 allows the user to move the slider 16 by manipulating the external magnet 35.

Fig. 6 shows another embodiment having a corrugated, black and opaque bottom surface 37 for increased light absorption. The corrugated bottom surface enhances the visibility of the film. An opaque tube 38 (preferably black) is provided around the clear window to also enhance the visibility of the soap film 22. The frame holding the soap film within the device of Fig. 5 can be a pivoting slider (as in Figs. 4 and 5) or translating slider (as in Figs. 1-3). Wall 58 is preferably black and opaque. The container of Fig. 6 can be rotationally symmetric about a vertical axis (i.e. approximately cylindrical in shape).

Fig. 7 shows another embodiment of the invention having a different geometry. The rails 14 extend between opposite inside edges of a cube-shaped container. Four of the 6 sides of the cube container are back and opaque. In this embodiment, the soap film 22 may slip off the frame due to surface tension effects. For this reason stabilizing rods 27 are preferably provided at each end of the frame. The rods 27 will tend to render the soap film stable within the frame.

Fig. 8 shows an alternative embodiment of the frame (the container is not shown for clarity) where the frame has wavy rails 14. The wavy rails produce a soap film 22 that is nonplanar. The nonplanar soap film 22 will have different color patterns than a planar soap film. The rails 14 can also be helical so that a twisted soap film is created.

Fig. 9 is a cross-sectional view of another embodiment of the invention wherein the container has a square shape. This embodiment is useful because the opaque black walls 36 are angled and so tend to reduce unwanted reflections. The slider moves in a direction perpendicular to the page.

Figs. 10a and 10b show cross-sections of two square-shaped devices supported on a flat horizontal surface 51. The devices have legs 53. The legs 53 are positioned so that the devices are bistable and can be tilted between two positions. One position in Fig. 10a tilts the soap film 22 so that liquid flows to the left. The other position in Fig. 10b tilts the soap film so that liquid in the film flows to the right. Flow directions are indicated by arrows. Preferably, the legs 53 have lengths selected so that the soap film is nearly (within 10 or 20 degrees) horizontal when resting on the horizontal surface 51. Horizontal or nearly horizontal positioning of the soap film 22 produces more interesting color patterns and makes the colors last longer compared to a vertical or nearly vertical soap film.

Figs. 11a and 11b show an alternative embodiment where a bottom of the container has two angled surfaces 47 49. The angled surfaces 47 49 are angled so that the device is bistable (i.e. both positions are stable). The angled surfaces 47 49 provide that the film 22 is at an angle less than about 10 or 20 degrees from horizontal when the device rests on a horizontal surface.

Fig. 12 shows another alternative embodiment having a spring 55. The spring 55 is attached to the container 10 at one end so that it can vibrate when plucked. When the spring vibrates, vibrations are transferred to the container and soap film 22. Vibrations in the soap film 22 cause fluid within the soap film 22 to flow in swirling patterns. The effect is strongest when the vibrational frequency of the spring is tuned to match a resonant standing-wave mode of the soap film 22. Preferably, the spring is tuned so that its resonant frequency matches a standing wave mode.

Fig. 13 shows another embodiment wherein the rails 14 have sloped ends 57. The sloped ends 57 may attach to a bottom surface of the container, as shown. Both ends of the rails may be sloped. The sloped rails 57 will tend to immobilize the slider at an end of the rail. Another advantage to the sloped ends is that it causes colors in the soap film to migrate toward the center of the rails, where they are most easily seen. The sloped rails can contact the container at 90 degrees, or at a smaller angle, as shown. The sloped rails can also be connected to the sidewalls of the container.

Fig. 14 shows a sideview of an embodiment having sloped rails 57 at both ends. The sloped ends 57 cause soap film colors to flow toward the center, as illustrated.

Fig. 15 shows yet another embodiment wherein the frame is tilted by external magnets 64. The frame has rotatable connections 62 and so can rotate about axis 70. External magnets 64 are attached to an external rod 63 that is rotatable. External magnets 64 are magnetically coupled to internal magnets 66. When external magnets 64 and rod 63 are rotated, the frame is caused to rotate as indicated by arrows 68, thereby tilting the frame and causing slider 16 to slide under influence of gravity along the frame and create a soap film. It is noted that the rod 63 is preferably not physically connected to the rotatable connection 62 (i.e. there is no rotary feedthrough).

Also, it is noted that the slider does not need to be rigid. For example, the slider can be flexible (e.g. the slider can comprise a length of plastic chain or string). In this case, if gravity is employed for moving the slider, then the slider should be heavy enough to overcome surface tension forces when creating a film. Also, it is noted that if a flexible slider is used, then the rails do not have to be parallel or equidistant along their length. The rails can be curved.

In the appended claims, a "magnetic element" includes any object or material that is attracted to a magnetic field, such as magnets and ferromagnetic objects.

The frame of the present invention can have any shape and configuration provided that it holds a soap film.

The slider of the present invention can have any shape or configuration provided that it can produce a soap film in the frame by sliding across the frame.

It will be clear to one skilled in the art that the above embodiment may be altered in many ways without departing from the scope of the invention. Accordingly, the scope of the invention should be determined by the following claims and their legal equivalents.